RF-87K1/2/5/9
User's Manual

Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

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Table of contents

1. Introduction

In order to reduce wire-placement tasks and conveniently manage data acquisition modules, ICPDAS provide a range of RF I/O modules to meet the above requirements.

The hardware structure is based on the ICPDAS I-87K series module and the software supports the ICPDAS DCON protocol, making it easy to integrate into any system.

There are three RF I/O series modules available for selection: RF-87K1, RF-87K2, RF-87K5 and RF-87K9. The last character of the model number denotes the number of slots.

The unique specifications of the RF I/O series modules means that it supports the ICPDAS I-87K series I/O modules, meaning that the old I-87K back end need only be changed to an RF I/O module and the system can be updated to a wireless network.

The RF-87K series is based on a direct sequence spread spectrum and RF technology, operating in the ISM bands with a Frequency Range of 2410.496MHz~2471.936MHz, with a Channel Spacing of 4.096MHz.

By changing the default antenna to a high gain antenna, the transmission range of the RF-87K series can be extended. In addition, the unique specifications of the RF-87K series allows the channel to be changed using a simple switch, meaning that most configuration problems can be easily solved when adding a new module. It is also easy to add an RF-87K series module to your existing SST-2400/2450 network.

Note that when ordering an RF-87K series module, I/O modules are not included and must be purchased separately. The RF-87K series also needs to operate with any device that is connected to the SST-2450.

2. Specifications

- ◆ **Frequency Range**:   2.4GHz (2410.496MHz ~ 2471.936MHz)
- ◆ **Channel Spacing**:   4.096MHz
- ◆ **Output Power**:   0.05W
- ◆ **Transmission Power**:   17dBm $\pm$ 2dBm
- ◆ **I/O types and number**:   Depends on the chosen I-87K I/O module
- ◆ **Modulation technique**:   GMSK
- ◆ **Radio technique**:   Direct sequence spread spectrum
- ◆ **Number of channels**:   16
- ◆ **PN code rate**:   1.365 Mchips/sec.
- ◆ **Communication distance**:   Depends on the type of external antenna, default is 300m
- ◆ **Setting Method**:   Switching
- ◆ **Antenna**:   Flexible
- ◆ **Data Format**:   N, 8,1
- ◆ **Data bit error rate Antenna**:   < 1/1000@ -102dBm
- ◆ **Input voltage**:   10~30V DC
- ◆ **Input current**:   Typically less then 250mA
- ◆ **Power Consumption**:   Transmit: 2W
  Receive: 1W
- ◆ **Dimensions**:   106mm (L) x 76mm (W) x 31mm (H)
- ◆ **Weight**:   200g
- ◆ **Operating temperature**:   -10°C~50°C
- ◆ **Operating humidity**:   0~90%

◆ The RF I/O module can work together with an SST-2450 or SST-2400 network (the 8051 chip of the SST-2400 must be changed).

3. Product Description

The last character of the RF-87K series model number identifies the number of available I/O module slots.

3.1 RF-87K1

Channel &
Init Switch

One slot for I-87K
I/O modules

3.2 RF-87K2

Init Switch

Two slots for
I-87K I/O
modules

Channel
Switch

3.3 RF-87K5

Five slots for I-87K
I/O modules

Init Switch

Channel
Switch

3.4 RF-87K9

Nine slots for I-87K
I/O modules

Channel
Switch

Init Switch
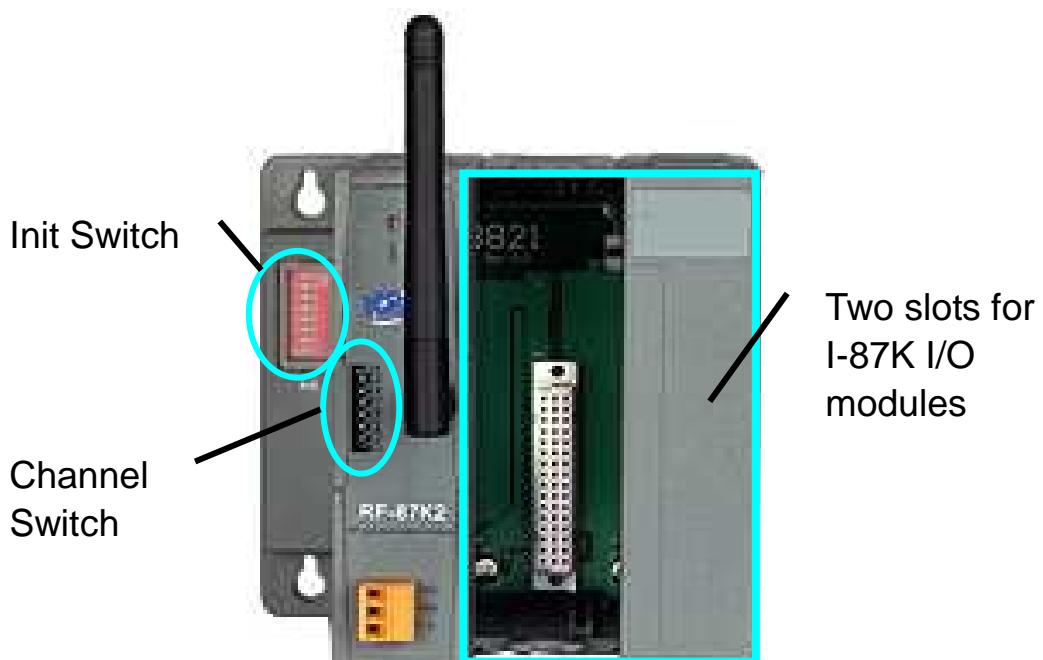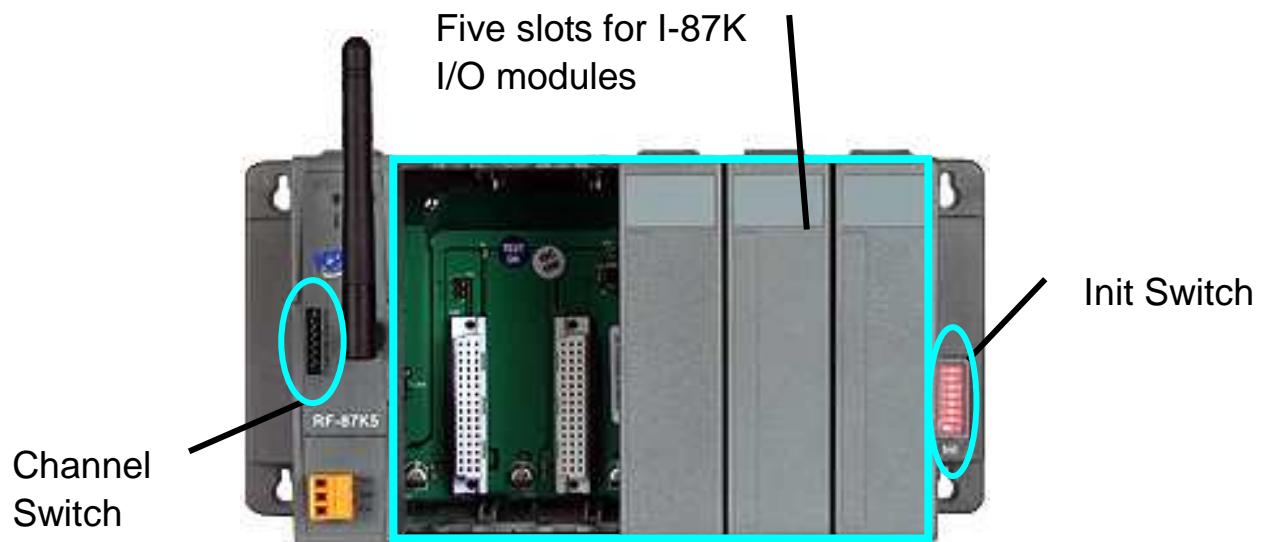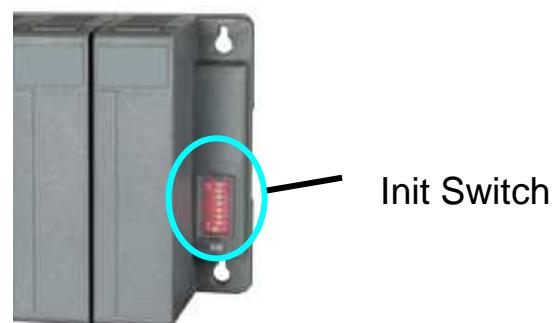
3.5 Block diagram
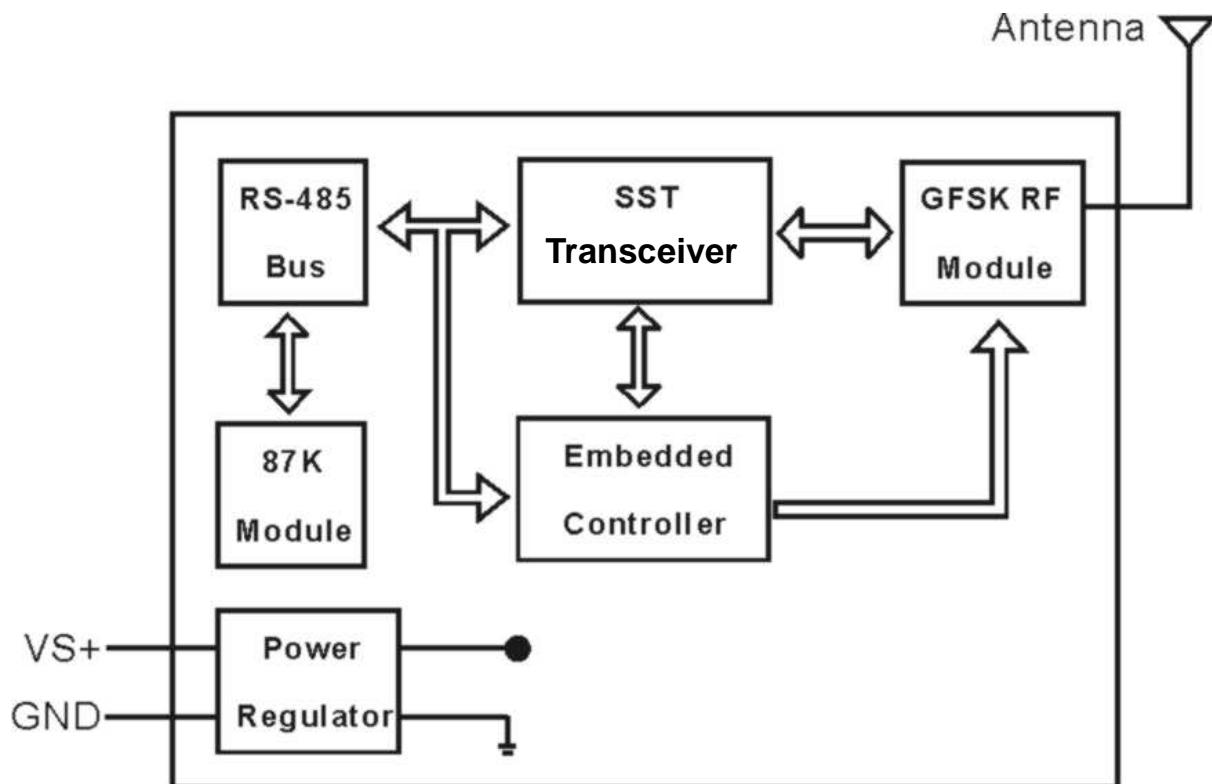
      RF-87K series modules contain two elements. The first is the RF module (for radio communication) and the second is the I-87K module slot (for data acquisition).

      When the Transceiver receives a signal from the RF module, it will forward the signal to the RS-485 bus. On the other hand, if the Transceiver receives a signal from the RS-485 bus it will forward the signal to the RF module.

      The RF-87K series wave signals cannot pass through metallic obstacles, so this product is not suitable for a metallic type environment.

      The signal is able to pass thorough a cement wall, but will be weakened to 50% of its efficiency for each 15cm of the wall thickness.

4. Application

4.1 PC to RF-87K series:

4.2 I-7188 series embedded controller to RF-87K series:
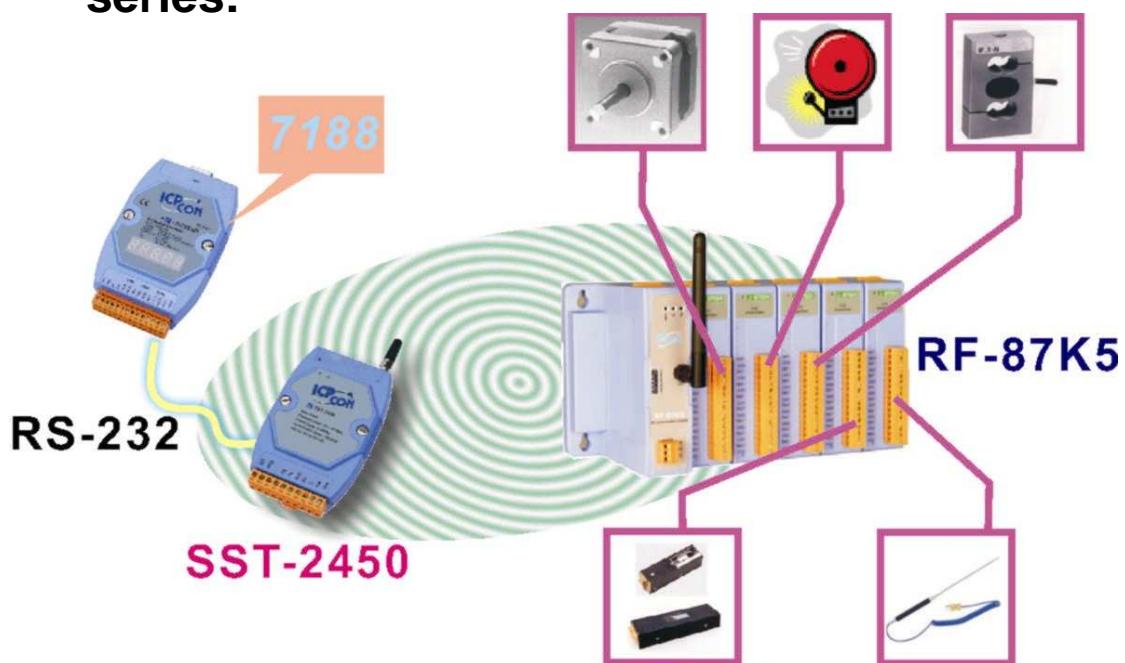
4.3 I-8000 series embedded controller to RF-87K series:


4.4 RF-87K series network:
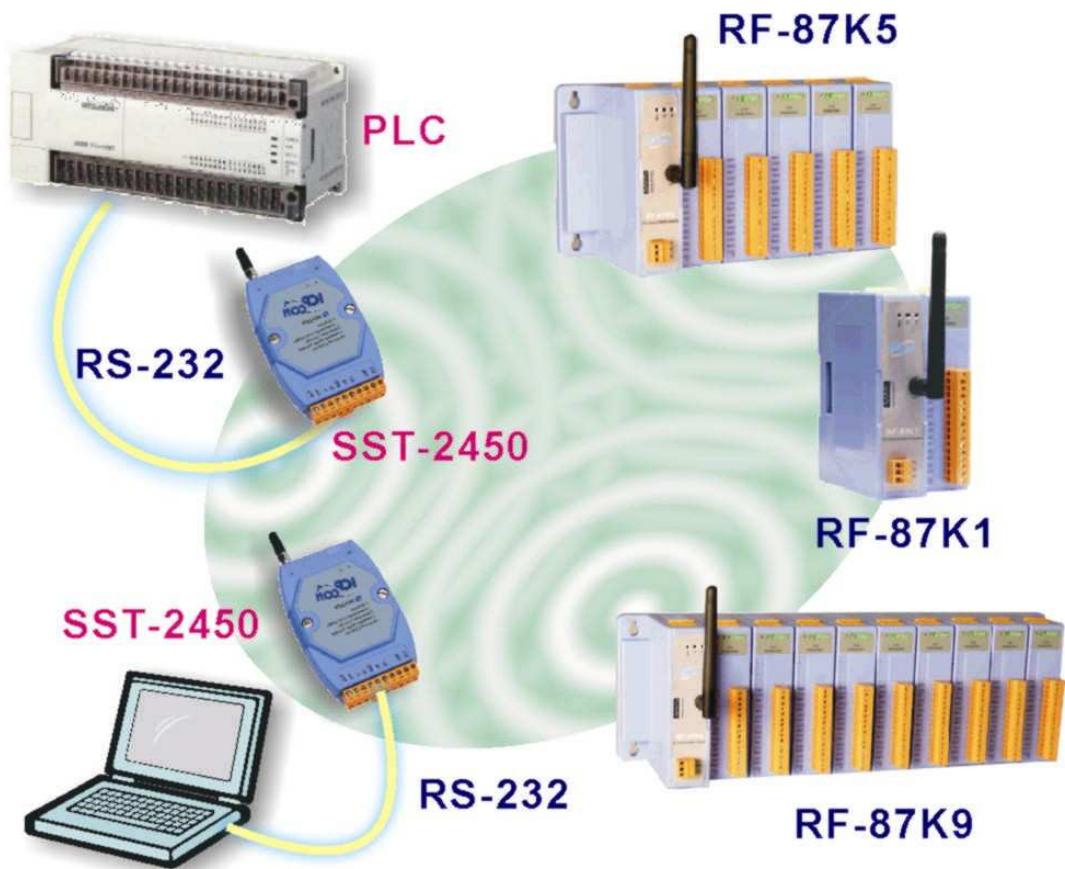
5. Setting the RF-87K series

5.1 Descriptions of the RF-87K series switches:

The definition is shown as below:
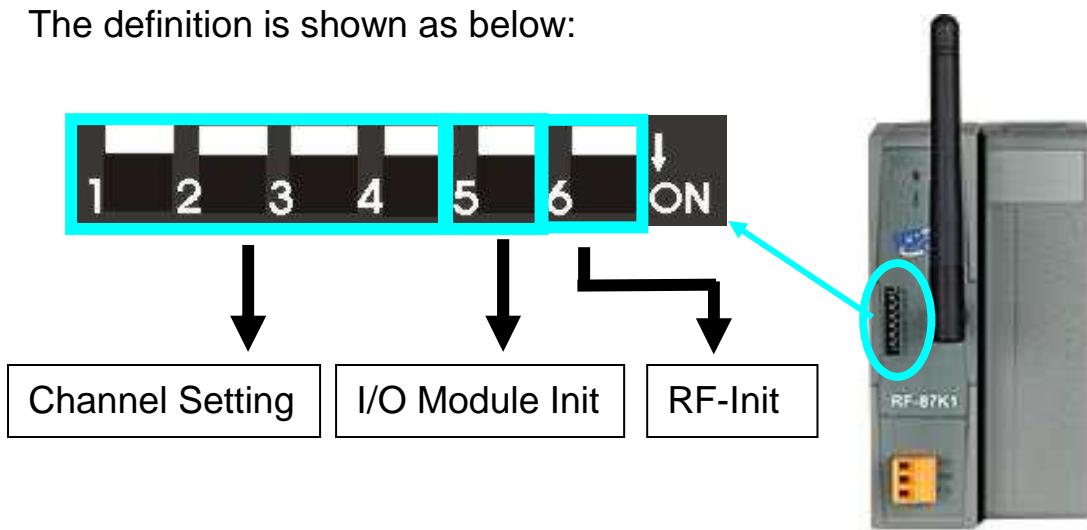
Channel Setting: The first four bits allow the user to select any of the sixteen channels. Refer to Table 5.3 in Section 5.3 for the relevant settings.

I/O Module Init: The fifth bit switch is only valid for the RF-87K1 module. When the position of this switch is adjusted to ON, the configuration of the I/O module that is connected to the RF-87k1 will be reset to the default settings (i.e. address = 01, Baud Rate = 115200bps).

RF-Init: The sixth bit is only used to set the configuration of the I-87K I/O modules. When the position of this switch is adjusted to ON, the Baud Rate of the RF-87K series will be changed from 9600bps to 115200bps.

5.2 Init Switch descriptions:

The RF-87K2/5/9 has an extra Init switch to set the channel and Init status. The positions and the definitions are shown as below:

RF-87K2   **RF-87K5**
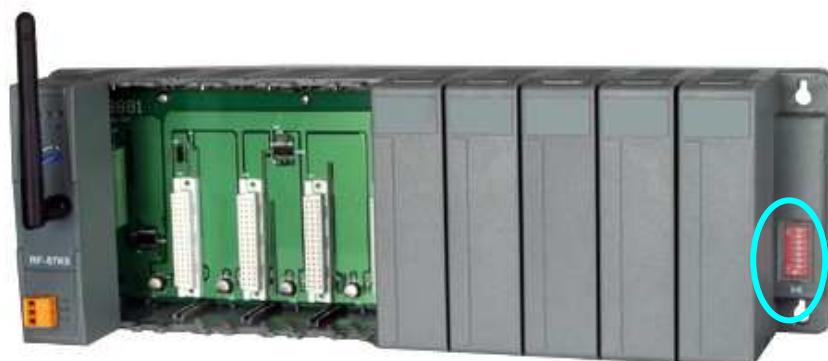
RF-87K9
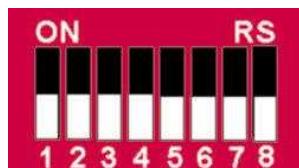
Init switch (the switch number corresponds to the slot number)

5.3 Channel Switch definitions:

In order to reduce the complexity of the configuration process, the RF-87K series limits all configurations apart from the channel number, which can be adjusted in order to avoid other 2.4G-frequency devices. The channel value can be changed using the Channel Switch. The channel value is formed using the 4-pin Channel Switch shown in Figure 5.3.

Figure 5.3.

Each pin corresponds to one bit. Pin 1 of the channel switch is the MSB, and pin 4 is the LSB. The ON position denotes that the bit value is 0. Otherwise, the value is 1. Please refer to Table 5.3 for additional available values.

Channel Switch and channel configuration for the RF-87K series									
Pin 1	Pin 2	Pin 3	Pin 4	Channel	Pin 1	Pin 2	Pin 3	Pin 4	Channel
ON	ON	ON	ON	0	OFF	ON	ON	ON	8
ON	ON	ON	OFF	1	OFF	ON	ON	OFF	9
ON	ON	OFF	ON	2	OFF	ON	OFF	ON	A
ON	ON	OFF	OFF	3	OFF	ON	OFF	OFF	B
ON	OFF	ON	ON	4	OFF	OFF	ON	ON	C
ON	OFF	ON	OFF	5	OFF	OFF	ON	OFF	D
ON	OFF	OFF	ON	6	OFF	OFF	OFF	ON	E
ON	OFF	OFF	OFF	7	OFF	OFF	OFF	OFF	F

Table 5.3.

5.4 Init Switch definitions:

The RF-87K series has one or more expansion slots to allow the connection of I-87K I/O modules. System Managers often have a difficult task when managing module configurations, and can often forget the configuration settings, if not properly recorded. An Init Switch has been included as a useful method for solving this problem.

The Init Switch pin number corresponds to the slot. In the firmware of each I-87K I/O module, there is a specific setting (module address 00) that will reset the module once it is notified that the Init Switch pin has been set to the ON position.

5.5 How to set the SST-2450 to communicate with RF-87K series modules:

The following table shows the internal configurations of an RF-87K series module. The values are fixed and cannot be changed by the user. Only the channel can be adjusted in order to avoid other 2.4G-frequency devices.

The internal configurations of the RF-87K series	
Communication interface	RS-485
Mode	Half-Duplex
	Slave
	Synchronous
Baud Rate	9600 bps
Data Format	N, 8, 1
P/N code	F

Table 5.5.

In order to correctly communicate with RF-87K series modules, the configuration of the SST-2450 should be set according to the table above.

5.6 How to set the configuration of I-87K I/O modules in the RF-87K series

5.6.1 RF-87K1

♦ Set pins 5 and 6 of the Channel Switch to the ON position as shown in the following figure.

♦ Power-off then power-on the RF-87K1.

♦ Launch the *[1][2] DCON Utility or terminal application to set the configuration of the I-87K I/O module.

♦ After setting the configuration, remember to return pins 5 and 6 to the opposite position.

♦ Power-off then power-on the RF-87K1.

Figure 5.6.1.

*(1) The DCON Utility can be found on the attached CD. The path is Napdos\Driver\DCON_Utility.

*(2) No matter what Baud Rate value is read via DCON Utility or terminal application, please ensure that the Baud Rate value is changed to 9600bps before completing the setting procedure.

<mark>5.6.2 RF-87K2/5/9</mark>

♦ Set pin 6 of the Channel Switch to the ON position as shown in figure 5.6.2-1

♦ Set the Init Switch pin corresponding to the required slot to the ON position. For instance, to adjust the configuration for the second slot of the I-87K I/O module, set pin 2 of the Init Switch to the ON position (refer to figure 5.6.2-2).

♦ Power-off then power-on the RF-87K2/5/9.

♦ Launch the *[1][2] DCON Utility or terminal application to set the configuration of the I-87K I/O module.

♦ After setting the configuration, remember to return pin 6 of the Channel Switch, and pin 5 of the Init Switch to the opposite position.

♦ Power-off then power-on the RF-87K1.

Figure 5.6.2-1.
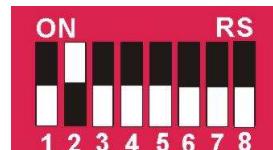
Figure 5.6.2-2.

*(1) The DCON Utility can be found on the attached CD. The path is Napdos\Driver\DCON_Utility.

*(2) No matter what Baud Rate value is read via DCON Utility or terminal application, please ensure that the Baud Rate value is changed to 9600bps before completing the setting procedure.

6. Dimensions

6.1 RF-87K1
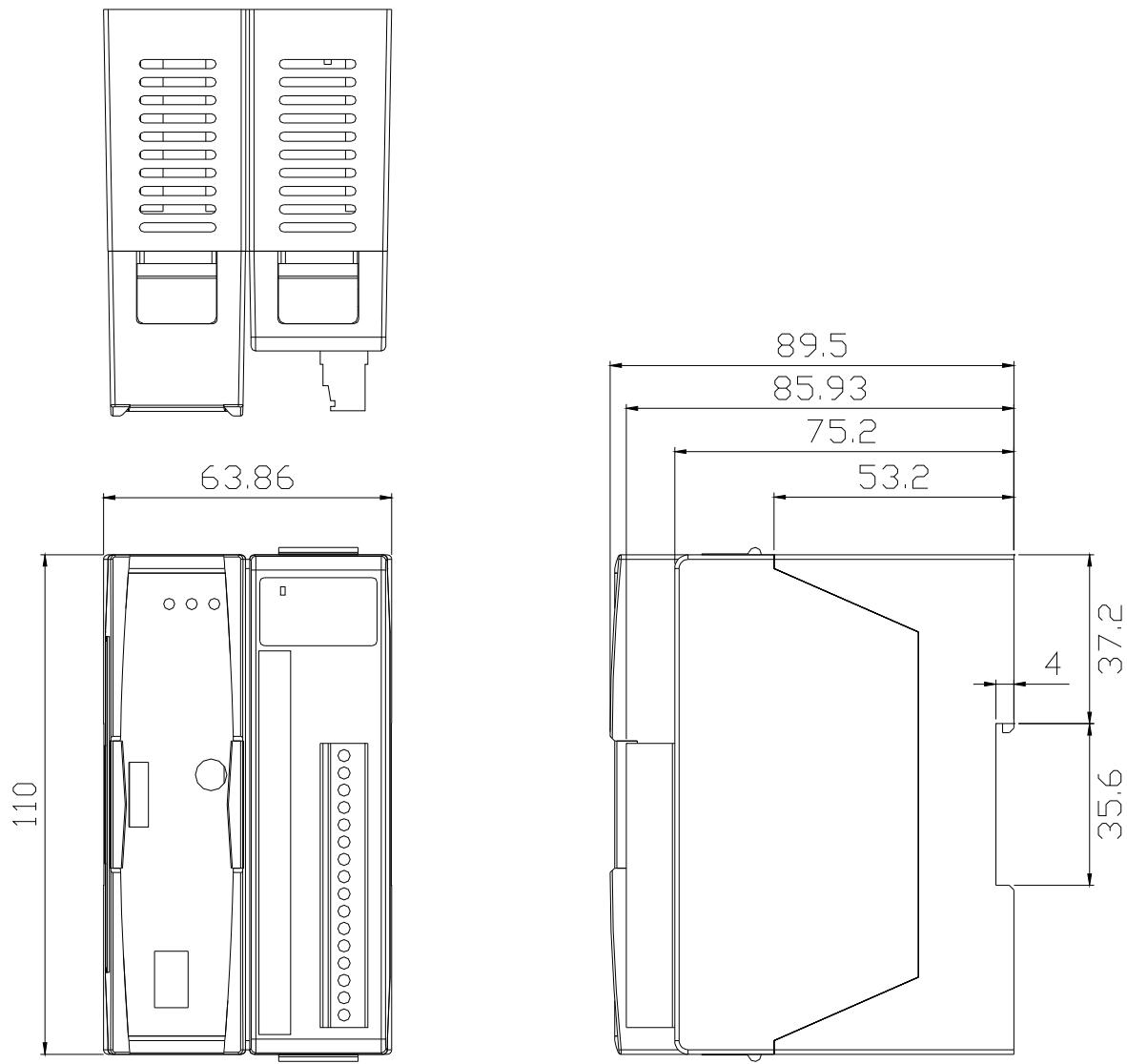
6.2 RF-87K2
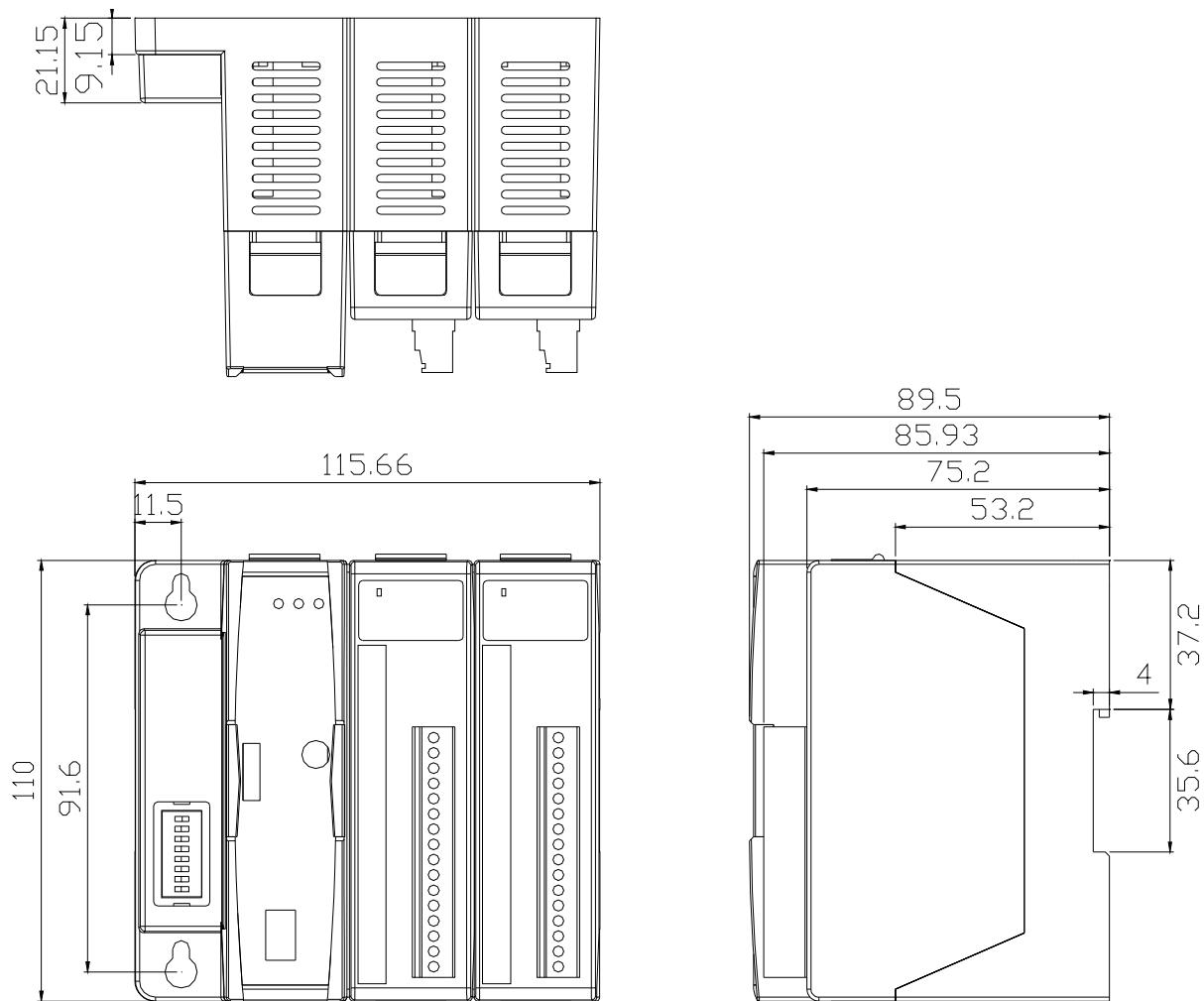
6.2 RF-87K5
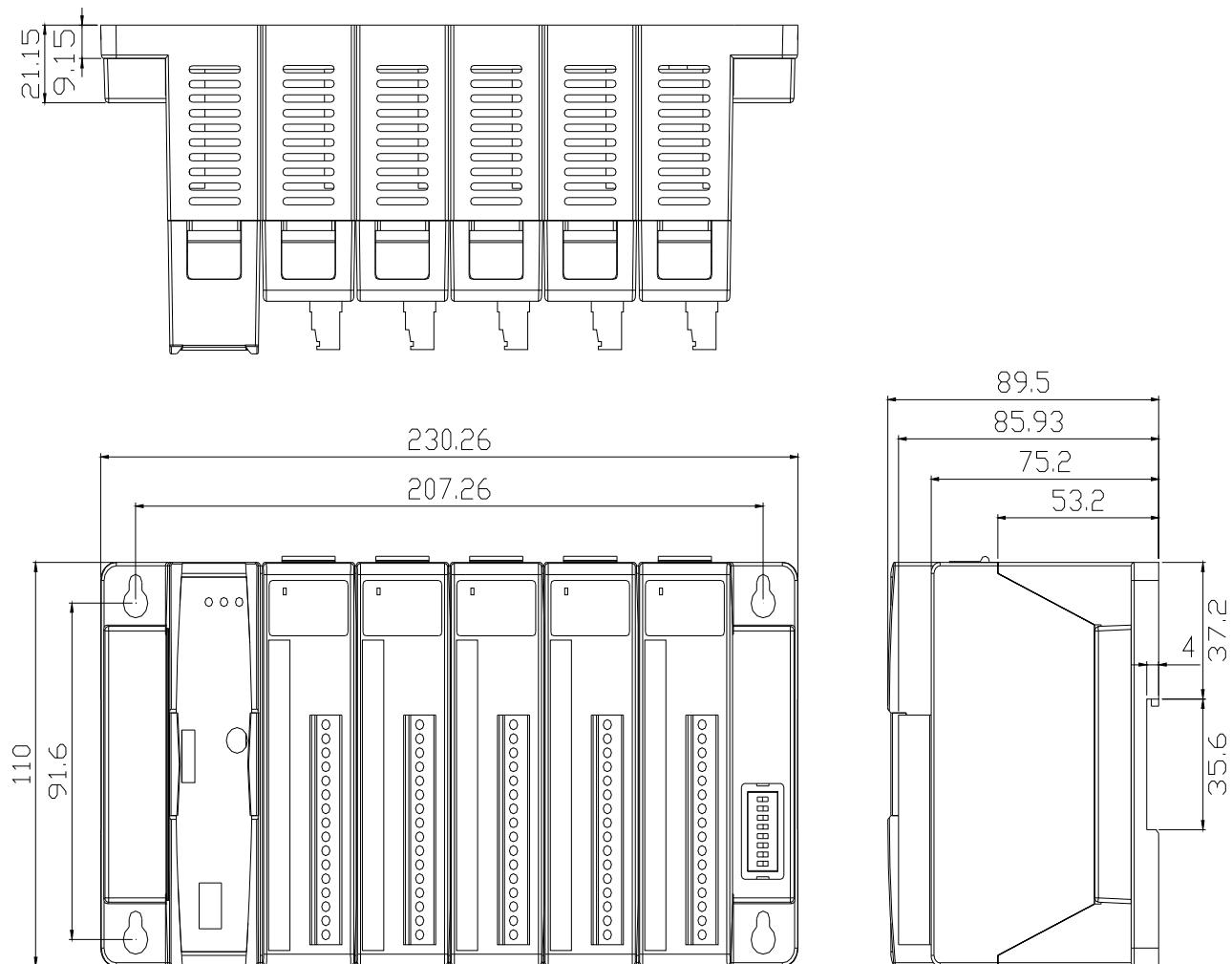
6.4 RF-87K9
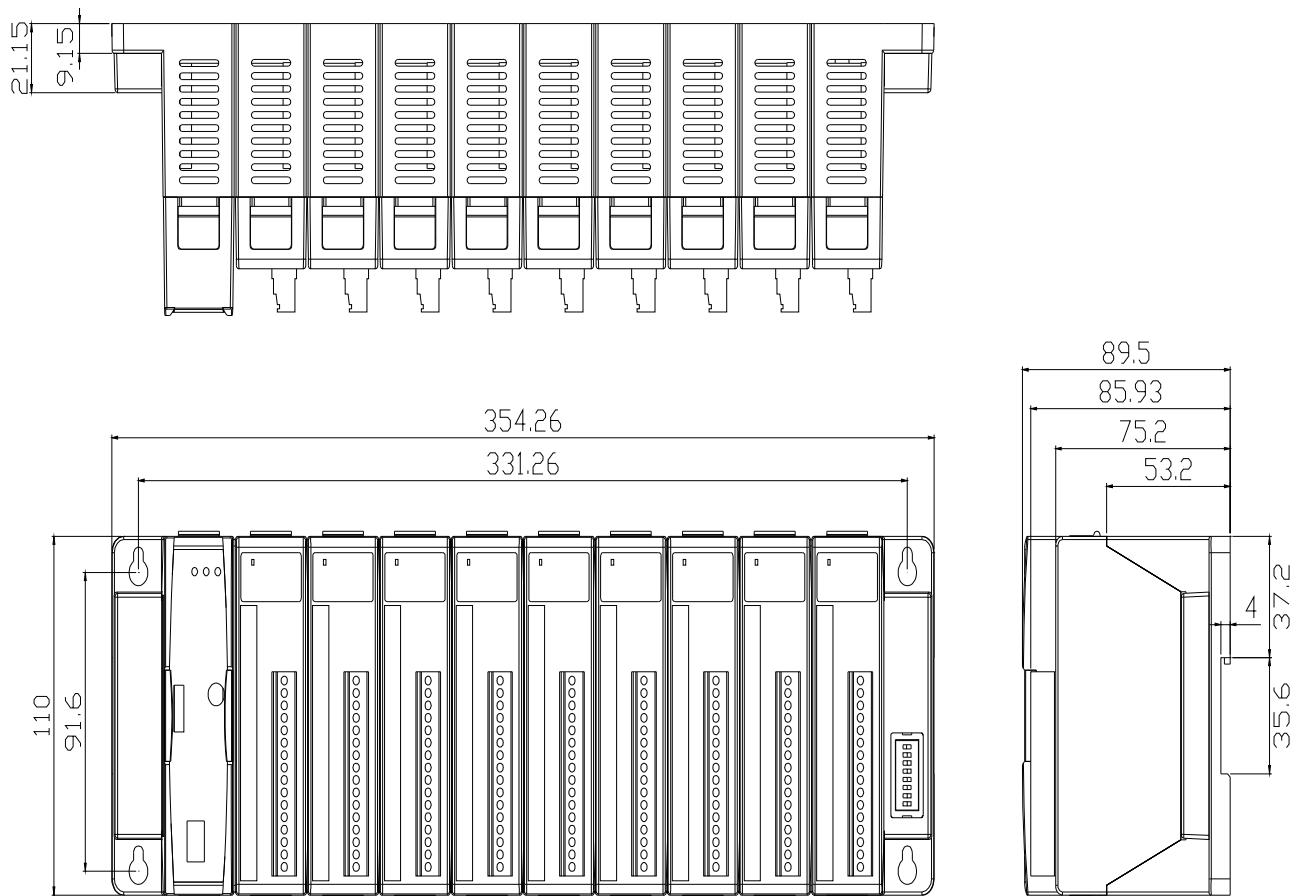
7. Accessories

Using an external antenna in conjunction with the SST-2450 allows the device to be used outdoors. The antenna is even water resistant. Simply replace the default antenna with an external antenna to allow data to be transmitted across distances of up to 1KM.

7.1 ANT-3 *(Directional)*

Gain: 3dBi
Polarization: circular
Power handling: 5W
Impedance: 50 Ohms
Connector: SMA
Cable: RG-58, 100cm
Dimension: 65mm x 65mm
Gain Pattern

Usage Diagram

ANT-3   1Km   ANT-3
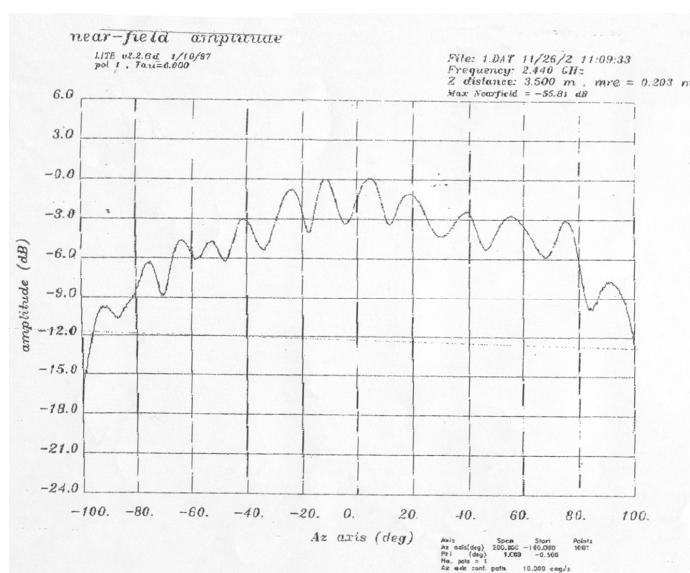
7.2 ANT-8 *(Omni directional)*

Gain: 8dBi
Polarization: Linear
Power handling: 10W
Impedance: 50 Ohms
Connector: SMA
Cable: RG-58, 100cm
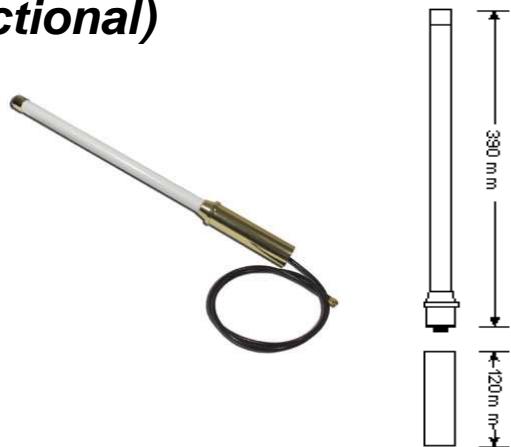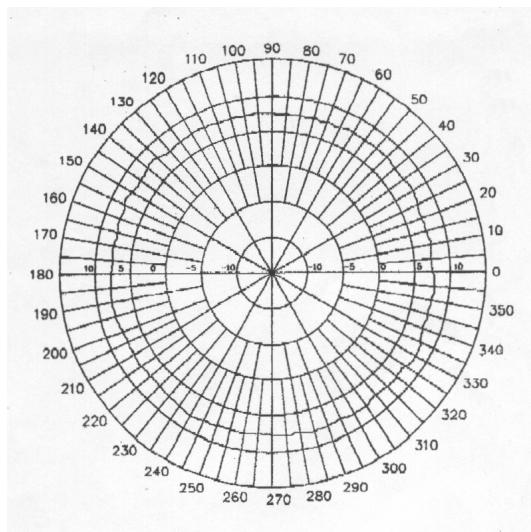
Gain Pattern

H-Plane Field Patterns
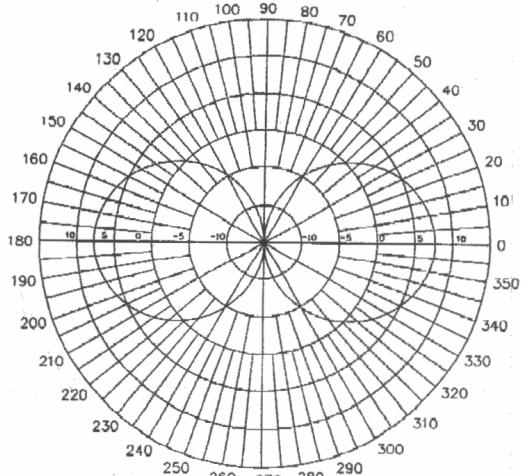
E-Plane Field Patterns
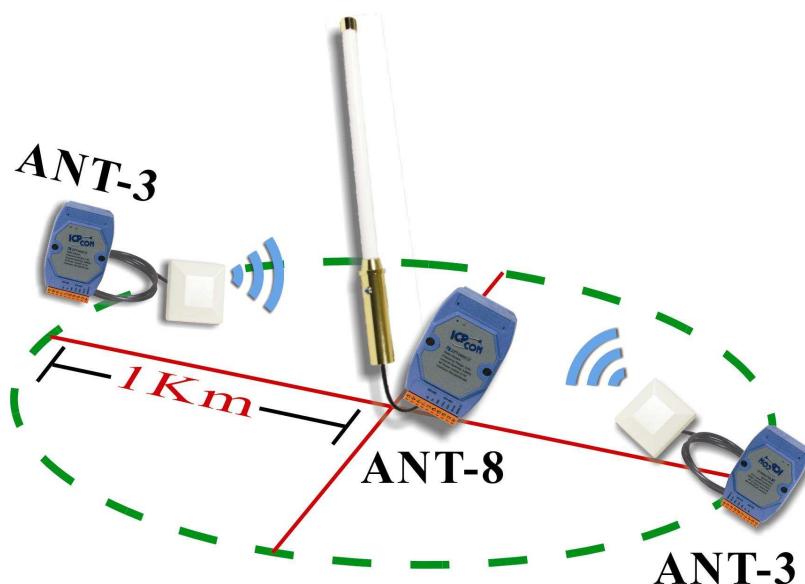
Usage Diagram

7.3 ANT-12P *(Directional)*

Gain: 12dBi
Polarization: Linear
Power handling: 10W
Impedance: 50 Ohms
Connector: SMA
Cable: RG-58, 100cm

Gain Pattern

H-Plane Field Patterns   *E-Plane Field Patterns*

Usage Diagram

5Km

ANT-12P   **ANT-12P**
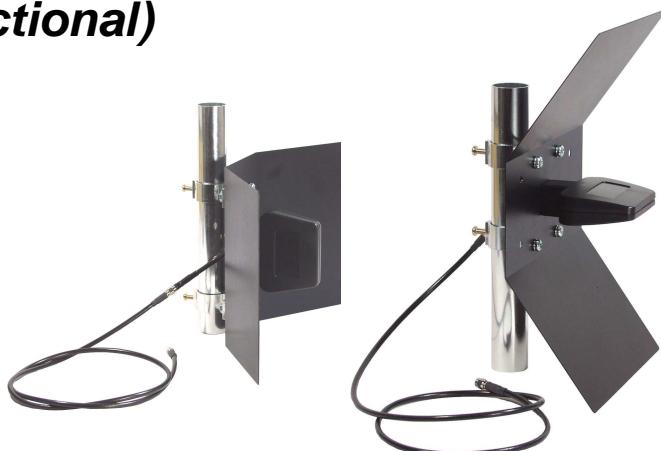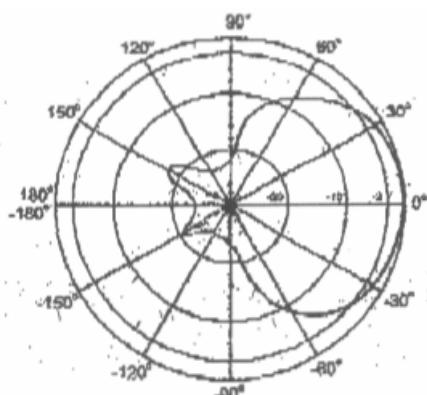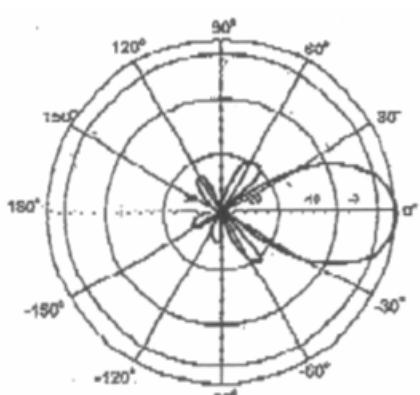
7.4 ANT-15 *(Omni directional)*

Gain: 15dBi
Polarization: Vertical
Power handling: 10W
Impedance: 50 Ohms
Connector: SMA
Cable: RG-58, 100cm
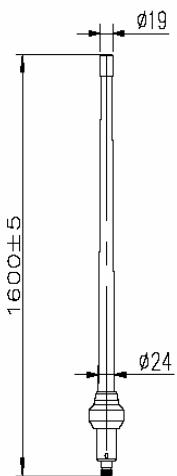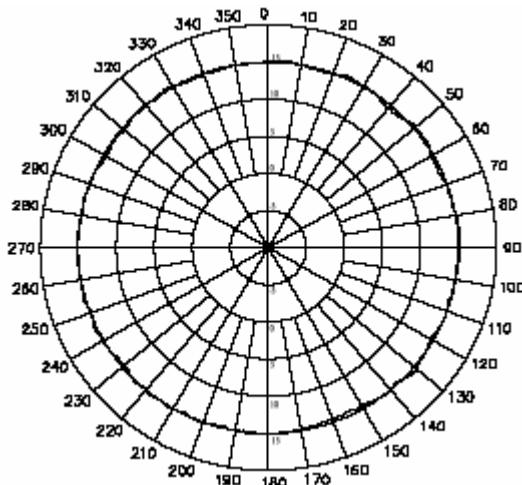
Gain Pattern

Usage Diagram
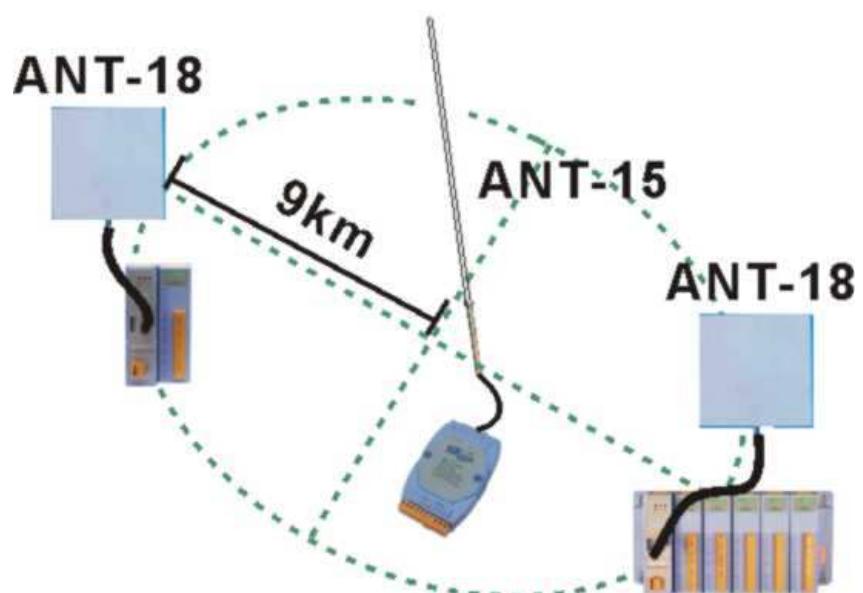
7.5 ANT-18 *(Directional)*

Gain: 18dBi
Polarization: Vertical
Power handling: 10W
Impedance: 50 Ohms
Connector: SMA
Cable: RG-58, 100cm
**Dimension:** 263 L x 263 W x 30H (mm)

Gain Pattern
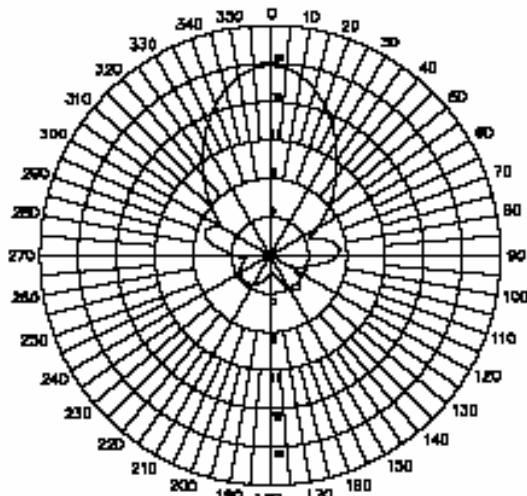
E-Plane Field Patterns
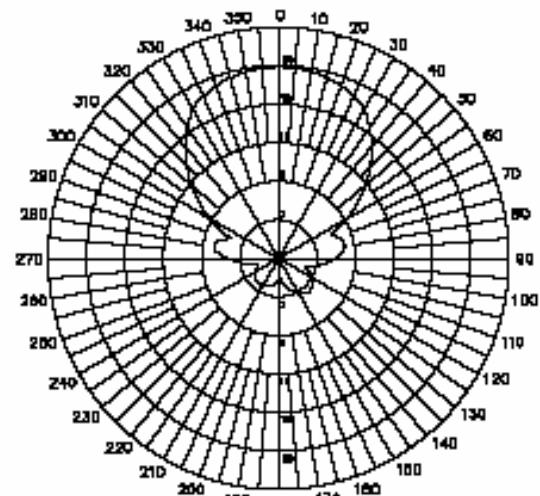
H-Plane Field Patterns
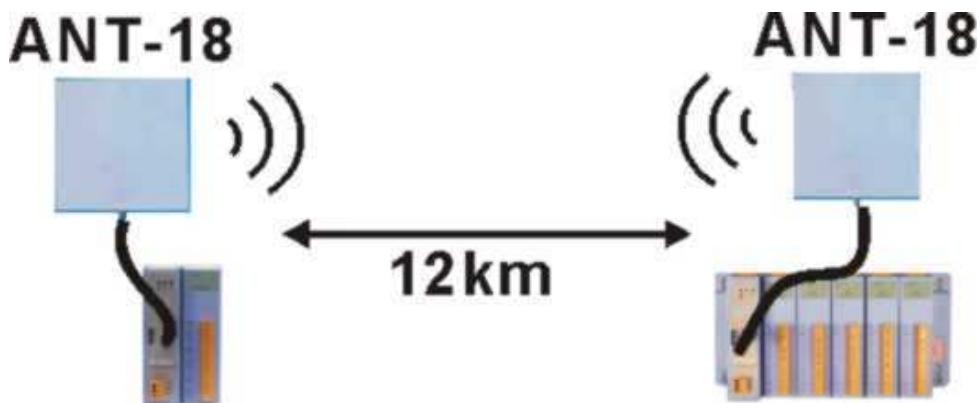
Usage Diagram

7.6 ANT-21 *(Directional)*

Gain: 21dBi
Polarization: Vertical
Power handling: 10W
Impedance: 50 Ohms
Connector: SMA
Cable: RG-58, 100cm
Dimension: φ 610 x150 (mm)

Gain Pattern
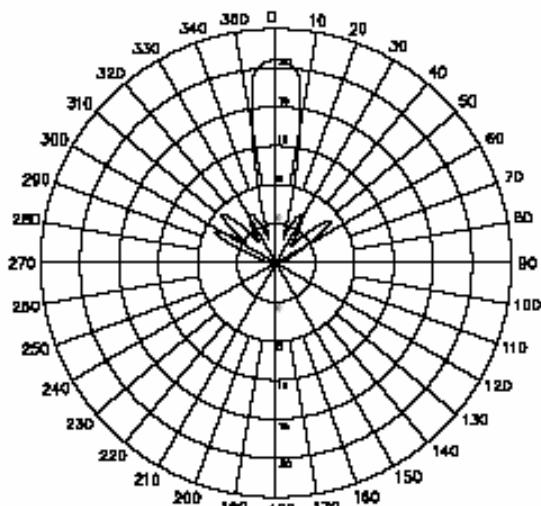
E-Plane Field Patterns
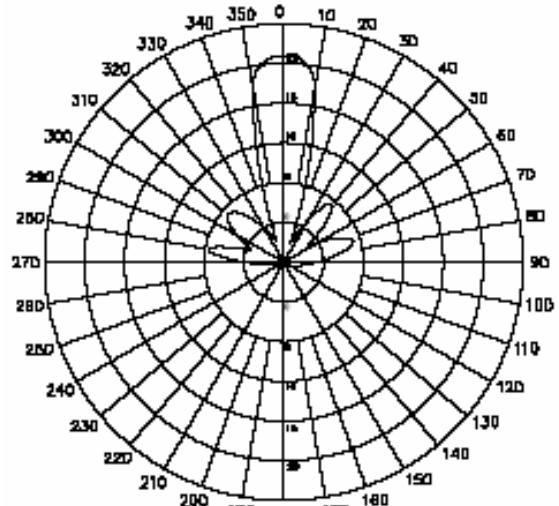
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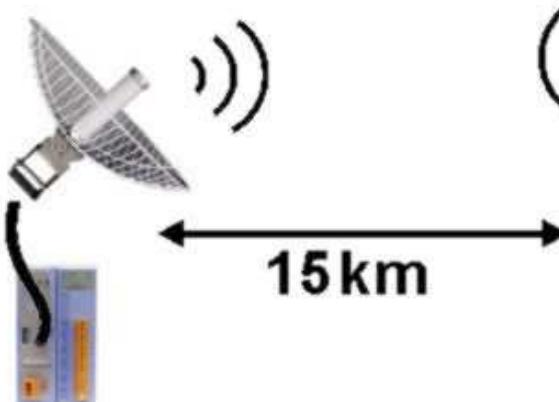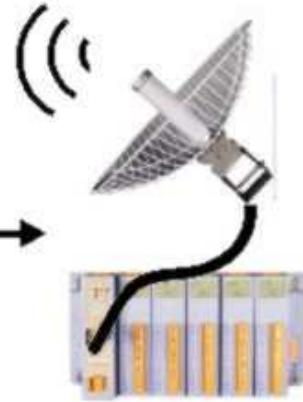
Usage Diagram

7.7 ANT-15YG *(Directional)*

Gain: 15dBi
**Polarization:** Vertical
Power handling: 10W
**Impedance:** 50 Ohms
Connector: SMA
Cable: RG-58, 100cm

Gain Pattern

E-Plane Field Patterns

H-Plane Field Patterns

Usage Diagram